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COMMON AIMS OF CULTURE AND RESEARCH IN THE UNIVERSITY[1]

BY definition universities aim to compass the whole range of knowledge. In practical operation they are characterized rather more by diversity than by unity of effort. It is in the nature of things that bodies so constituted should attempt to express the various phases of thought represented through many kinds of organization, and we expect to see philological, chemical, biological and other types of clubs or societies forming a normal part of the machinery of every great educational institution. According to the particular interests of the moment these agencies within the walls group themselves in different ways to accomplish specific kinds of service.

The most interesting of all organizations peculiar to the university are the two widely inclusive societies representing scholarship or culture in Phi Beta Kappa and research and science in Sigma Xi. These two bodies express in their aims nearly the whole range of higher purposes of academic effort. It has seemed to me that a study of their interrelations, extending to a redefinition of their common objects, might help to set forth that continuously needful statement and restatement of the reason for existence of institutions of higher learning. Inclination to consider the purposes of these societies has been particularly strong as the course of my life has carried me into contact with research and education in such a manner as to bring into close relation, and yet into striking contrast, the types of academic mind which we call scientific and humanistic. Having seen these interests so frequently defined with special reference to their separateness the desire has grown

[1] Presented as the annual address before Phi Beta Kappa and Sigma Xi, University of Pennsylvania, June 13, 1921.

to secure a better understanding of their true relations.

Although recognizing fully the specific aims of scientific and of humanistic investigation one can not avoid being impressed with the importance of considering the similarity of their methods and purposes. It is particularly desirable to consider this interrelation as a great group of thinking people still holds humanistic and scientific problems so different that common criteria may not be used generally in their solution.

Scholarship and culture as they are involved in the aims of Phi Beta Kappa have been considered often to represent a goal quite different from that toward which the scientific investigator strives in Sigma Xi. Scholarship should mean understanding and wisdom, not merely information. Culture has been taken to represent refinement of educational attainment and appreciation of knowledge, coupled with the development of personal characteristics giving that balanced judgment sometimes known as mental poise. Culture should furnish perspective and interpretation. Its perspective should make it possible to fit into their proper relations all available facts and to determine the position which new knowledge should take. In its truest expression it should be active and not passive, constructive and not absorptive. The imitative spirit is its greatest danger. True culture is a comprehensive vision and an attitude of the active interpreting mind.

Sigma Xi was organized to promote comradeship in research. Its activity has been limited not infrequently to the so-called natural history subjects. I am unable to conceive of this organization as functioning logically if it does not cover the whole range of investigative or constructive thought in which the scientific method is used. I think of it as standing for development of the attitude of mind which produces the builder, rather than for conduct of specific researches within a limited field.

Research has been defined as a reaching out to bring together, organize and interpret whatever may be added to our store of knowledge. It may express itself in the most intensive studies in very narrowly defined regions, but is most truly exemplified when it involves the wider relationship of specific facts to the whole structure of knowledge.

In the processes of research it is difficult to distinguish between those operations which are merely the gathering and those which are interpretation and definition. Simple collecting of materials without giving them their proper places and without interpreting them is work of a relatively low order and is doubtfully classed as original investigation.

By definition the present discussion is limited to relationships between culture and research as expressed in the university. A clear understanding of my purpose, therefore, involves recognition of the real aim in university activities. Without intending to offer a complete classification of the objects and plans of educational work it may be well to set forth the following as representing some of the aims of university life. These are, first, to hold before young men and women the mirror of knowledge and experience in which they may be able to see reflected the qualifications which fit them individually for this or that profession; second, to give classified information; third, to develop wisdom or judgment; fourth, to stimulate the growth of constructive or creative ability; and, fifth, to inculcate the element of character, which defines our relation to the world of human life. The highest aims of education are far from being generally understood. Many still think of this agency as informational rather than constructive, teaching imitation rather than initiative, and as focussed upon the past rather than the future.

One of the most fully valid criticisms of university study lies in the fact that too often it looks backward without adequate expression of relation between past and future. The young men and women who form the student body are at that early stage in which they have practically no past and naturally live in the present and future. Their eyes are turned forward with keen expectation of what the coming years may bring. Life and movement of life are to them the supreme enjoyment. Until their individual pasts begin to evidence marked effect upon the trend of their futures, uninterpreted history and experience

represent to them only shadowy forms or objects of ill-defined curiosity. Quite in contrast to the ideas of youth the machinery of the university may lend itself to too strong emphasis upon what is behind us. Thus educator and educated seem to look in opposite directions, and like Lot's wife, who "looked back from behind him," the educator may become as lifeless as a stone or fossil without sensing the change, while the company of youth moves on.

With a well-ordered program of university work, development of constructive ideals in the student inevitably carries with it in the scientific studies an unlimited series of questions regarding the relation of each element of nature to other items or forces, and requires recognition of continuity or law through all space and through past, present and future. Similarly in humanistic study the ideals of conduct and character come to rest upon realization of a continuity of interests and responsibilities in the world of human life. These ideas of interrelation, which may in one sense be called law, are necessary to the clear expression of both research and culture. Scientific understanding of nature depends upon our realization of the continuity of its principles of being and action. The meaning of what is covered by culture and scholarship we shall not know adequately until we understand the interrelations of events in the history of human institutions.

Large use of the principle of unity is essential if we would succeed in attaining the ideals of education either in science or in culture. The university programs which have greatest value are not prepared for the immediate future of the student but concern rather his activities at the time of maximum effectiveness. If the student's life be of normal span he graduates near 21 and his period of greatest value to the world lies between 35 and 65, or from ten to forty years after graduation. If the many years of education are to count in the stage of most fruitful service, the work must be carefully planned for attaining this end. It should be clear that the most valuable information which the student carries away is not comprised in the immediately practical things for use to-morrow or the next day, but in the basic principles and methods which in later years will help to answer the new and critical questions certain to arise, and in the answering of which there will be the largest opportunity for personal development. The details of specific studies in university experience are largely lost, but the attitude of mind resulting from honest thought, and the elemental laws which furnish the foundation for all constructive work will be of increasing importance.

From the point of view of culture and also of science the subject of history is one of the greatest of all agents for making possible our understanding of the principle of continuity. History has not too often been considered a science, although in its effect upon the human mind its operation is almost identical with the idea of continuity or unity in physical laws. It has had too small a part among the great opportunities of humanistic education. Oddly enough the tritest phrase growing out of this study is that "history repeats itself," and therefore we seem only to be studying a past which in effect may be repeated in the present or future. But what is it that history repeats? In addition to the idea of continuity, the most evident things coming out of historical research are that history expresses two almost unvarying principles, one, instability, the other, progress; one the view that everything is subject to change; the other that this instability includes in its operation a general movement toward what is more complex and in the realm of intelligence toward fuller comprehension and understanding. I am willing that this statement be challenged, and shall not attempt within these narrow limits to give it full defense. It may only be remarked that if this view be accepted there is no greater lesson to teach a student than that, contrary to commonly accepted conservative views, the future in which he will live his life will not be like either the present or the past. The direction of movement in the future may, however, be indicated by the evidence drawn from a careful scrutiny of history.

In preparation for later life, the well-

trained student of history will look forward with a definite expectation of shifting lines, and should be prepared for those situations in which judgment may be exercised either to accelerate or to retard the natural movement of progress. The laws of history show us a normal instability which should be recognized and capitalized. We should expect to interpret the trend of events. The gift of intelligence puts before us the opportunity to help naturally with normal progress. The possibility which increased knowledge gives for greater evil does not mean that evil must therefore be done. It is only an evidence of wider range of capacity. It is scarcely conceivable that with all the consequences clearly understood real intelligence could permit the following of a path that would lead to its own destruction.

It is difficult to discuss the influence of culture in the broader sense upon science and research, or the relation of these two elements with the current reversed; but in the hope that the effort will be understood as an attempt to view the problem constructively, I venture to suggest what seem to be some of the normal interactions.

Let us assume for immediate purposes of this discussion that the essence of research is the attempt to understand, organize, utilize and increase our store of knowledge. The only persons who are not believers in the value of research are those who studiously keep away from the borders of knowledge. To one who has investigated in any subject our painful limitations are only too evident. The successes of research in every field within the past decade show that the possibilities open more widely with every discovery. One of the most dangerous types of people we may have engaged in handling affairs of moment is that which assumes all useful knowledge to be comprised within the facts already assembled and fails to recognize the possibility of progress in nearly every direction in which we choose to investigate.

Progress in discovery and in constructive thought has increased our social inheritance so rapidly that the luxuries of one age often become necessities of the next. If life is defined as a form of motion, true living in the human sense is a state of motion in which the conditions seem not fully satisfied without a kind of advance which we call progress. I doubt whether happiness is possible without a sense of accomplishment, either individually or socially. Research by bringing a stream of new materials into application serves as one of the most important agents for making human progress and happiness possible.

In order that we may know the materials with which we are to work in the future, education must present organized and simplified knowledge to each incoming generation. In addition to pointing out what is already known it is the duty of the university to indicate the direction in which progress may be expected or desired. It is important that special stress be laid upon the kind of thought and the methods necessary for progress in order that the future investigator may do his part. Among the greatest teachers within or without the university we rank those who have set forth not only what is known but also what should be known and should be done. In general they have shown the way by example as well as by precept and have been among those advancing exploration, discovery and philosophic interpretation.

I believe that the lessons of history suggest continued advance or progress of the human type, both in social organization and in physical being. Social evolution represents an unbroken train of experience and therefore gives the greatest possibilies for accumulation of power and of opportunity to use it. In this type of evolution research is the most effective instrument employed. Physical evolution is related to replacement of individuals in the succession of generations. Without physical advance the limits set for mental capacity in individuals will mean the ultimate attainment of a level of social evolution beyond which we may scarcely reach; but what I see of history expands my optimism to accept the view that nothing within our horizon of information gives evidence that the final stage of physical betterment is yet in sight. I do not believe that with increasing knowledge we shall lose such opportunity for advance as may still be open to us.

Research in science has suffered severely, both within and without the university, by reason of failure to recognize the magnitude of the field in which it operates and the interrelation of the elements comprised in it. The researcher must, by definition, be a specialist, in that he should understand more fully than any other person the height or depth or breadth of a particular element or law of nature. Narrow specialization is often considered to represent research, and contraction of the limits of investigation is not infrequently desirable. But the greatest specialist does not merely go up high or down deep. He sees from these advantageous positions the real significance of his explorations. If he proceeds far in any direction without interpreting what is learned in terms intelligible to others, the journey has been merely a personal excursion and not a contributing voyage of discovery.

I come therefore to speak particularly of the need for contact between research and culture, in order that the broader human relation of culture and scholarship may bring to research a better power of expression and a deeper interest in its ultimate significance, thus making more useful the fruits of discovery. Research may profit greatly by contact with every human interest involved within the wide comprehension of culture. Much of the material uncovered by constructive work in science has not reached utility or become real contribution to humanity by reason of the view that investigation is complete without interpretation, or that it is an end in itself without regard to human use or meaning.

Science and research have missed great opportunities because of aloofness from the more strictly humanistic aspects of investigation extending into the realm of culture. Problems of research have so multiplied within the field of natural science that there has perhaps been good reason for our failure to discover that the most complicated, and therefore in many ways the most attractive problems possible to the investigator are above and beyond those which have mainly engaged our attention. Important as are the nature of matter, chemical affinity and organic evolution, some of the greatest fields for discovery still relate to the fundamental understanding of human behavior and cultural interests, both in the individual and in the group sense. With adequate cooperation between the scientific investigator and the humanist research should advance rapidly in the study of man and his cultural expression. Investigation of the physical basis of mental action may never produce such results as have recently revolutionized natural science. On the other hand, it may be that human research will go farther beyond our present knowledge than radioactivity has carried us forward in physics. Are we to believe that man, probably the most complicated of all objects or instruments in the universe, may be neglected as the object of research by reason of his high level of development? Is it not clear that added knowledge, such as should be secured by united effort of the scientific investigator and the humanist, would give further control of our powers and greater satisfaction in their use?

It is with the hesitation of one known as a representative of the scientific school that I touch upon the other phase of the problem, namely, the possible contribution of research to culture and scholarship. If I were to indicate what might from my point of view seem a dangerous element in scholarly and cultural studies as contrasted with the situation in science and research, it would be to suggest that there is not in any branch of knowledge a finished chapter or a closed book, and that there is no field in which the principle of growth and progress may not be expressed profitably through constructive work. Culture must in some measure stand for conservatism and precedents. Theology tends by definition to be one of the most rigid of all phases of human thought, but scholarship stands next in rigorous adherence to standard. This condition is natural. Even the normal instability of evolution shows generally a stately and unhurried movement which illustrates the idea of standards in rate of change. The researcher states, "There is more unknown than known"; the scholar says, "We have before us only the known and must therefore base our practical lives upon it."

Scholarship in a passive or conservative position diminishes its value. Culture not merely sets standards of form but may also indicate the rate of progress. It may not only require that we know the best from the past, but should demand the best that can be secured in the present and future. The study of human actions and interests is not to be limited by assumption that creation, even in the human sense, is ever complete, or that existing states of law or culture are final. Science and research should be tied to the humanistic group of agencies for a combined investigation of problems of every kind relative to man. Culture should be a constructive force with the authority of history, and an active source of ideas and ideals.

Research and cultural activities not merely overlap and have common aims, but their highest expression develops through influence of similar types of constructive ideals. The idealism which gives life and hope to culture and science may be academic, unprofessional, or even unfashionable, but it has contributed much toward securing the present privileges of humanity. The practical man insists that he is limited by what is and not by what might be. The idealist dwells upon what should be, with the hope that what is, by reason of its instability and by virtue of the laws of change, may ultimately come to be the thing desired. The practical man with his hands tied by what he *must* do sets precedents and limits which sometimes bind the wheels of progress. The idealist, with the widest view of unity and movement reaching through the universe of being and of thought, visualizes the larger possibilities and helps to sweep away obstacles in the path of advance along lines of natural development.

And so, without further expansion of this view, it is clear that I do not hope to see less diversification in university activity but only more unity. We should represent here every type of thought. We must assemble, organize, interpret and construct in every region over which knowledge may extend. We must have differing types of mind and multifarious points of view. With meticulous refinement of technique some will seek out the minutest details of obtainable information and set them in order with relation to the ocean of available facts. Some will work upon the nature of matter and others on the theory of the state. But with all this differentiation, the principles of unity, or law, and the interrelation and interdependence of all knowledge should everywhere be recognized and made the basis of advance in thought. The delight in construction and the joy in expectation of progress should be lessons of experience which no one could fail to understand. Culture and scholarship should help science and research to better orientation. The explorer and builder should be imbued with that culture which gives the clearest vision of the road for human progress.

We must not forget that for each individual the end and aim of university effort is the securing of that knowledge which fits him into the niche in which he may perform the largest service; and that the university is not an apprentice shop, but is a source of ideals and a type of environment peculiarly fitted for growth of constructive minds. Let us be clear that whatever the university gives represents wasted time, effort and material, unless it is received in a spirit of reverence and with the idea that the greatest satisfaction lies in service as a builder who does not work for personal ends. It is said that geniuses are born, not made; but those who come into the world to live non-contributive, purely individual lives, leaving the world no better than they find it, we may truthfully say are only made, not born. Contribution to meet real human needs gives perhaps the only way by which we obtain full right of recognition as individuals in the strictly human sense. We may not know why living things must grow if they would live, or why history has given a choice between progress and oblivion, but the thinking world has always recognized the validity of this view.

We remember that the Great Teacher explained to Nicodemus the Pharisee: "Marvel not that I said unto thee, Ye must be born again." With all the spiritual meaning that this saying carries may it not suggest to us also that constructive service gives, with a sense of reality, a new and true life, a verifiable personality in the kingdom of creative beings. What greater work can a university perform than through its vision, its constructive power

and its culture to open the way to that kind of service which brings the joy of progress and the continuing rewards of real accomplishment.

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THE WORLD'S SUPPLY OF IODINE IN RELATION TO THE PREVENTION OF GOITRE[1]

OWING to the varying reports as to the concentration of iodine in sea water, I have made a number of determinations on water dipped from the Santa Monica, Cal., pier. Even after filtration, this water contained so much colloidal material as to interfere with the determinations. It was finally observed that thorough shaking with carbon tetrachloride and filtration removed this sufficiently to make analysis possible. The carbon tetrachloride was purified by the addition of a drop of bromine, action of sunlight and shaking with an excess of sodium thiosulfate solution. In determining this excess, some very dilute sodium carbonate solution was poured into the carbon tetrachloride and tenth normal sodium thiosulfate run in, about half a cc. at a time, followed by shaking, until the color disappeared. This solution was separated off and more carbonate and about two cc. of thiosulfate added with thorough shaking, followed by separation of the water phase. The carbon tetrachloride was then dried and distilled, the first distillate being rejected.

It was found that evaporation of the sea water until sodium chloride began to crystallize out made it acid, due to precipitation of calcium carbonate and the hydrolysis of $MgCl_2$, magnesium being a weak base, but there was no loss of iodine. Furthermore, a dry salt could be made of the sea water, without appreciable loss of iodine. This was accomplished by evaporation until the calcium carbonate precipitated; precipitation of the remaining calcium and magnesium by the addition of 100 cc. of seven per cent. Na_2CO_3 solution for each liter of original volume; filtration; washing the precipitate on the filter and evaporation of the filtrates to dryness.

[1] From the Southern Branch, University of California, and the University of Minnesota.

In the analysis of the iodine content of salt, it was dissolved in water and the same procedure followed as with brine. In analyzing water or brine, standard solutions of the same NaCl content but varying concentrations of iodate were made up and treated in the same way as the unknown. The quantity of reagents added varied with the samples, and no portions were thrown away until the yield of iodine was found to be complete. Each sample if not near neutrality, was neutralized, using test paper, and about 10 cc. of concentrated HCl per liter added. In case buffers were present, at least enough acid was added to react acid to brom-phenol-blue (or methyl-orange). An excess of arsenious acid was added to reduce the iodate to iodide, the equivalent of 1 to 10 cc. of tenth normal per liter, and allowed to stand 20 minutes or more. At this stage colloids, if present, were removed. One per cent. sodium nitrite solution was added to the extent of ten times the quantity of arsenious acid. The sample was then extracted with several portions of carbon tetrachloride, which were then collected in a separatory funnel. In cases of 0.04 milligram per 100 cc. of the sample, a pale pink color could be detected in the carbon tetrachloride. The smallest workable quantity, often 1 cc. of very dilute (less than 0.1 per cent.) sulfurous acid was shaken with the extract until complete extraction of the iodine was effected. The carbon tetrachloride was removed from the sulfurous acid solution and a drop of concentrated sulfuric acid added, followed by sufficient sodium nitrite solution to oxidize the sulfurous acid and completely oxidize the iodide to iodine. The iodine was extracted with a sufficient quantity of carbon tetrachloride to fill the colorimetric apparatus (which varied in nature with the size of the yield) and compared with the standards. There must be nearly the same quantity of iodine in the final standard taken for comparison as in the unknown, and the treatment must be identical, quantitatively, especially in regard to volume relations and thoroughness of shaking.

The quantity of iodine found in the sea water was 0.05 milligrams per liter, which is a confirmation of the findings of Winkler for